

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 14	OF	72
---------------------------	---	------------	----	----

NAME OF OFFEROR OR CONTRACTOR

• DESCRIPTION AND SPECIFICATIONS

PROCUREMENT SPECIFICATION

FOR

ARS-50 CLASS

INTEGRATED MACHINERY CONTROL SYSTEM

Version 1.1

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 15 OF 72
---------------------------	---	--------------------------------

NAME OF OFFEROR OR CONTRACTOR

1. GENERAL SPECIFICATIONS	16
2. ENCLOSURE MATERIAL AND DESIGN.....	21
3. PLC ENCLOSURE COMPONENTS	21
4. PLC SUB-SYSTEM REQUIREMENTS.....	24
5. OPERATOR TERMINALS	42
6. CONTRACTOR ASSEMBLED SYSTEMS GENERAL REQUIREMENTS	43
7. ENVIRONMENTAL SPECIFICATIONS	46
8. TRAINING	46
9. SPARE PARTS	46
10. TECHNICAL SUPPORT	47
11. TECHNICAL MANUALS.....	47

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE	
	N65540-00-R-0031	16	OF 72
NAME OF OFFEROR OR CONTRACTOR			

1. GENERAL SPECIFICATIONS

- 1.1

This specification has been developed to establish minimum hardware requirements for a Integrated Machinery Control System (IMCS) that will control the Propulsion, Electrical, Damage and Auxiliary Machinery onboard the ARS-50 Ship Class. The objective of the new Control System will be to improve reliability, maintainability, and efficiency by reducing Total Ownership Cost (TOC) and downtime. The new system shall be designed to easily interface to existing shipboard systems. A laboratory version of the shipboard control system will be installed at NSWCCD.
- 1.2

The Machinery Control System will be comprised of multiple Programmable Logic Controller (PLC) based units. The PLC units will consist of a single main enclosure or two (2) enclosure pairs; a PLC Enclosure and a Support Enclosure. Each PLC unit (either single or dual enclosure) shall be designated as a PLC System.
- 1.3

Single Enclosure PLC System - Single unit enclosures shall consist of a PLC Chassis, PLC I/O (Discrete and Analog) Modules, PLC Processor, Supporting Power Supplies. The enclosure shall contain all necessary hardware to interface the field machinery with the PLC Enclosure including terminal block/strips for terminating all required field wiring, power supplies required for loop and I/O power, and any necessary relays, transducers or other electronics.
- 1.4

Dual Enclosure PLC System – Dual unit enclosures shall consist of enclosure pairs designated as the PLC Enclosure and Support Enclosure. Both enclosures shall contain a PLC I/O rack and all necessary hardware to interface the field machinery with the PLC Enclosure including terminal block/strips for terminating all required field wiring, power supplies required for loop and I/O power, and any necessary relays, transducers or other electronics. The PLC Enclosure shall contain the PLC Processor that will control the I/O racks in both enclosures. The PLC Enclosure I/O rack shall contain Analog I/O modules while the Support Enclosure I/O rack shall contain Discrete I/O modules.
- 1.5

Eleven (11) PLC Enclosure Systems shall be provided for interface and control of the ARS Machinery Plant. The Machinery Plant signals will be distributed among the 11 PLC Enclosure Systems. The following table lists the single and

NAME OF OFFEROR OR CONTRACTOR

dual enclosure PLCs. The final configuration is subject to change by the government.

PLC System Number	Configuration
1	Dual
2	Dual
3	Dual
4	Dual
5	Dual
6	Dual
7	Dual
8	Dual
9	Single
10	Single
11	Single

- 1.6** The Eleven PLC Systems shall be connected to a Government Furnished Fiber Optic Ethernet Local Area Network that will provide inter PLC communications and communications with Windows NT Based Processors also connected to the network. The Windows NT based processors will contain the Man Machine Interface (MMI) Computer Program. The Windows NT based Processors and MMI Computer Program shall be provided and developed by the Government. The Contractor shall be responsible for providing a software interface between the MMI and the PLCs.
- 1.7** As part of the Control System two (2) displays shall be provided that will connect directly to two (2) of the PLC Enclosure Racks that will provide communications with the corresponding PLC processors. The displays will act as local Man Machine Interfaces. The displays will be specified in a proceeding section of this specification.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 18	OF 72
---------------------------	---	------------	----------

NAME OF OFFEROR OR CONTRACTOR

- 1.8** The PLC/Support Enclosure Systems shall be able to interface with the following I/O signal types. The device codes provided will be used in Contractors design documentation:

AI – Analog Input
AO – Analog Output
DI – Discrete Input
DO – Discrete Output

DEVICE	RANGE (VDC/MA)	NOTE
I10	0-10 VDC	
I12	0-7.5 VDC	
I14	0-24 VDC	
I15	-10 to 0 VDC	
I20	4 to 20 MADC	Loop Power
AI21	4 to 20 MADC	Source Power
AI25	0-5 Amps AC	
AI30	0-10 VDC	
AI35	0-5 VAC/0-2000 HZ	Magnetic Pickup
AI40	92.9 to 200 OHMS	RTD
AI41	0 to 50 MVDC	Thermocouple
AI50	0 to 160 VAC	
AI51	0 to 5 VAC	
AI53	380 Hz TO 420 Hz	
AI55	-180 to +180 DEGREES	
AO10	0 to 10 VDC	
AO11	0 to 5 VDC	
AO20	0-1 MADC	
D042	MAINTAINED -12 VDC	
DI01	N/A	Normally Closed Contact
DI11	N/A	Normally Open Contact
DI12 *	28 VDC RETURN WHEN AXC	Supervisory Normally Open
DI13 *	28 VDC RETURN WHEN AXC	Supervisory Normally Closed
DO10	CONTINUOUS +24 VDC	
DO15	CONTINUOUS +28 VDC	
DO20	MOMENTARY +24 VDC	
DO21	MOMENTARY +28 VDC	

CONTINUATION SHEETREFERENCE NO. OF DOCUMENT BEING CONTINUED
N65540-00-R-0031PAGE
19 OF 72

NAME OF OFFEROR OR CONTRACTOR

DO25	+28 VDC RAISE/-28 VDC	
DO30	MOMENTARY +5 VDC	Provide Open Contact
DO31	MOMENTARY +5 VDC	Provide Closed Contact

* These signals have a 7K ohm resistor installed across the switch contacts

- 1.9** There are approximately 1100 machinery plant signals that need to interface with the Control System. The approximate signal distribution per PLC System (either single or dual enclosure) is as follows:

DEVICE	PLC 1	PLC 2	PLC 3	PLC 4	PLC 5	PLC 6	PLC 7	PLC 8	PLC 9	PLC 10	PLC 11
AI10	4		2	1							3
AI12											
AI14											
AI15	1		1								
AI20	8	16	8	20	5	16	13				13
AI21	4	2	2	2	1	1	1				
AI25								4	2		
AI30	1	1	1	1	1	1	1				
AI35	1		1								
AI40	14	6	14	6	10	10	11				
AI41	18	18	18	18	18	18	18	1	1		1
AI50								7	2		
AI51					3			7	6		
AI53									2		
AI55									3		
AO10		1	2		1	1	1	3			11
AO11											
AO20											
D042											
DI01	5	5	5	4	2	2	2	4			
DI11	51	38	43	42	24	55	38	25	17		5
DI12	2	4	3	3	2	4	4			129	
DI13											
DO10											
DO15					2	2	1	7			15
DO20	4	4	5	5							
DO21	3	1	2	1	1	1	2	17			
DO25	1		1								
DO30	4	4	2	6	1	12	6	1	4		
DO31	4	13	3	13	8	7	7	22	13	6	1

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 20	OF 72
NAME OF OFFEROR OR CONTRACTOR			

The preceding signal distribution is to be used as a guide for estimating purposes. The Government shall furnish the exact signal distribution within 30 days after contract award.

- 1.10** Two Relay Boxes will be included in the control system that will interface with PLCs 1,2,3 and 4. The relay box enclosures will be of the same material as housing the PLC enclosures. The relay boxes will each include 2 time delay relays adjustable 0-30 seconds, 6 24 vdc mechanical or solid state relays and terminal boards. The government will provide detailed relay box specifications after contract award.
- 1.11** A complete set of the control system suitable for a laboratory will be installed at NSWCCD for long term software maintenance. This set will include all 11 PLC enclosures. The enclosures need not be of the shipboard material but must be mounted on laboratory suitable self-supporting stands or enclosures. The laboratory set will include all fuses, terminals and other hardware devices that are installed on the shipboard set.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE		
	N65540-00-R-0031	21	OF	72
NAME OF OFFEROR OR CONTRACTOR				

2. ENCLOSURE MATERIAL AND DESIGN

- 2.1** The PLC and Support enclosure cannot exceed the dimensions of 36 inches high, 30 inches wide, and 12 inches in depth excluding space required for shock mounts and heat sinks.
- 2.2** Enclosures shall be rigid, self-supporting structures, with suitable structural reinforcement, stiffening and bracing. When panels are assembled, the surfaces shall be flat and smooth.
- 2.3** Enclosures and enclosure shock mounts shall be capable of withstanding shock and vibration according to MIL-S-901D “shock” and MIL-STD-167-1 “vibration”. Enclosures shall be EMI hardened and shall be capable of meeting the requirements of the current version of MIL-STD-461.
- 2.4** All enclosure doors shall be removable by means of removable hinge pins or means of a non-hinged removable door.
- 2.5** All enclosures shall be drip proof.
- 2.6** Each enclosure shall have a phonemic nameplate attached representing the enclosure and function.
- 2.7** Conservation of weight shall be considered when at all possible. All components and material shall be selected using the lightest material possible yet still remain compliant to all-applicable standards and functionality.
- 2.8** Enclosures shall be designed to accept plant interface cables through nylon stuffing tubes. The design must be made to facilitate connection with existing plant cables. Using information provided by the government the Contractor will provide removable gland plates on two sides of the enclosures so they can be removed to drill holes for the stuffing tubes.
- 2.9** The interface between the PLC Enclosure and the Support Enclosure shall be made via coaxial cable used for ControlNet communications. The Government shall furnish exact cable lengths within 30 days after contract award.

3. PLC ENCLOSURE COMPONENTS

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 22 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- 3.1** Each PLC Enclosure shall contain the PLC I/O Chassis, PLC Processor, PLC I/O modules, supporting power supplies and terminal boards
- 3.2** Each Enclosure shall house all necessary hardware necessary to interface the field machinery with the PLC Enclosure including terminal block/strips for terminating all required field wiring, power supplies required for loop and I/O power, and any necessary relays and transducers. All spare PLC I/O card channels shall be wired to spare terminal block points.
- 3.3** All internal enclosure wiring terminations will require tinning or ferruling.
- 3.4** All enclosure wiring will be low smoke and meet the requirements of MIL-C-24643 or MIL-C-24640. Non-PVC wire will be used in the enclosure.
- 3.5** All hardware of the Programmable Controller Enclosures shall be capable of operating at an ambient temperature of 0 to 55 degrees C (32 to 130 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F).
- 3.6 PLC I/O Chassis**
- 3.6.1** The PLC I/O Chassis shall be back-back or back stub mounted
- 3.6.2** The PLC I/O Chassis shall be available in multiple sizes. Depending on the PLC enclosure the PLC I/O chassis shall be capable of holding up to 8, 13 or 17 modules.
- 3.7 PLC Chassis Power Supply**
- 3.7.1** A PLC Chassis power supply shall be included in each PLC Enclosure. This power supply shall supply backplane power to the PLC Processor and I/O Modules. It shall be mounted external to the PLC I/O chassis.
- 3.7.2** The Programmable Controller Power Supply shall operate in compliance with an electrical service of 85-130 VAC, single phase, in the frequency range from 57 to 63 Hz, or 19-32 VDC.
- 3.7.3** The PLC power supply shall automatically shut down the Programmable Controller System whenever its output current is detected as exceeding 125% of its rated current.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE		
	N65540-00-R-0031	23	OF	72
NAME OF OFFEROR OR CONTRACTOR				

3.7.4 The PLC power supply shall monitor the incoming line voltage for proper levels. When the power supply is wired to utilize AC input, the system shall function properly within the range of 85 to 130 VAC. When the power supply is wired to utilize DC input, the system shall function properly within the range of 19.2 to 32 VDC. In addition, the power supply shall provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line. A clear plastic cover shall be mounted over high voltage terminals that are easily accessible to maintenance personnel.

3.7.5 In cases where the AC line is especially unstable or subject to unusual variations it shall be possible to install a constant voltage transformer having a sinusoidal output waveform.

3.7.6 At the time of power-up, the power supply shall inhibit operation of the processor and I/O modules until the DC voltages are within specifications.

3.7.7 The power supply shall have fuse protection.

3.8 PLC Processor, I/O Modules and Chassis

3.8.1 The PLC Processor, I/O Modules and Chassis make up the PLC Sub System. The design requirements for the PLC Sub System will be discussed in proceeding sections.

3.9 Other Power Supplies

3.9.1 A 24Vdc, adjustable 10 Amp power supply shall be installed into each enclosure, where required. The power supply voltage adjustment must be accessible without having to remove any power supply components (e.g. power supply cover). This power supply shall provide loop current for incoming 4-20ma signal transmitters, is used in conjunction with PLC output module to provide output voltage to the plant and is used to monitor contact state of discrete input signals.

3.9.2 Any other necessary power requirements will be met by using DC-DC converters.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 24	OF 72
NAME OF OFFEROR OR CONTRACTOR			

3.9.3 The power supply shall not fluctuate for loads between 1 and 10 Amps

3.10 Terminal Blocks

3.10.1 IEC Type terminal blocks shall be supplied for connection of discrete and analog inputs and outputs to field wiring connectors.

3.10.2 All terminal blocks shall be organized and marked to establish easy identification of signals.

3.10.3 Fused terminal blocks shall be provided for 4-20ma transmitters, discrete input and discrete output signals.

3.11 Transducers and Signal Conditioners

3.11.1 Any transducers, signal conditioners or other electronic devices necessary shall be mounted and wired in the PLC Enclosure.

3.11.2 All components will be properly tagged for easy identification.

3.11.3 Transducers shall have gain and offset adjustments and shall be mounted in such a way that the adjustments are accessible without having to remove any enclosure components.

4. PLC SUB-SYSTEM REQUIREMENTS

4.1 The PLC System is made up of the PLC Processor, PLC I/O Modules and PLC Chassis.

4.2 PLC System Design Considerations

4.2.1 A major consideration of the Programmable Controller sub-system shall be its modular, field expandable design allowing the system to be tailored to the ARS

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 25	OF 72
NAME OF OFFEROR OR CONTRACTOR			

machinery and/or process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user software.

- 4.2.2** The processor plus input and output circuitry shall be of a modular design with interchangeability provided for all similar modules.
- 4.2.3** Modules are defined herein as devices that plug into a chassis and are keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot via an electronic method for identifying a module. Electronic keying shall perform an electronic check to insure that the physical module is consistent with what was configured.
- 4.2.4** All system modules shall be designed to provide free airflow convection cooling. No internal fans or other means of cooling except heat sinks shall be permitted.
- 4.2.5** All system modules including the processor may be removed from the chassis or inserted into the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
- 4.2.6** The Programmable Controller Sub-System shall have downward compatibility whereby all new module designs can be interchanged with all similar modules in an effort to reduce obsolescence.
- 4.2.7** The Programmable Controller Sub-System shall have the ability to be updated electronically to interface with new modules.
- 4.2.8** All hardware of the Programmable Controller System shall operate at an ambient temperature of 0 to 55 degrees C (32 to 130 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F).
- 4.2.9** The Programmable Controller Sub-System hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 26 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- 4.2.10** The Programmable Controller Sub-System shall be designed and tested to operate in the high electrical noise environment of an industrial plant.
- 4.2.11** The Programmable Controller Sub-System shall provide a means for mounting the chassis in an Enclosure.
- 4.2.12** The PLC Processor shall have the capability of addressing up to 10000 discrete points or 1000 analog points. It shall also have the ability to communicate with up to 50 physical nodes that contain I/O.
- 4.2.13** Each input and output module shall be a self-contained unit housed within an enclosure. These input/output enclosures with their respective modules shall be field expandable up to 512 (16 modules x 32 pts/module) unique points.
- 4.2.14** The Programmable Controller shall include the capability of addressing remote input and output modules via ControlNet and a Remote Serial Link. The Remote Serial Link shall have a communication speed no less then 230 Kbaud and a distance of up to 1000 feet from the processor.
- 4.2.15** The Programmable Controller shall use multiple independent, asynchronous scans. These concurrent scans shall be designated for processing of input and output information, program logic, and background processing of other processor functions. Input and output devices located in the same backplane (local I/O) as the CPU will produce at the rate of configured RPI (Requested Packet Interval), and for inputs enabled for Change Of State (COS), at the time any point changes state. Scan rates for devices located in backplanes other than that in which the processor is located should be user selectable and range from 2-100 milliseconds.
- 4.2.16** The Programmable Controller shall be possible to communicate with remote I/O racks or other PLCs via fiber optic cable by inserting fiber optic converters into the links. The fiber link must support distances between converters up to 6500 cable feet. Redundant fiber optic cabling shall be an option.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 27 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

4.2.17 The Programmable Controller System shall have the ability to support multiple data communication links by using ControlNet, Serial Interface and Ethernet Modules.

4.2.18 The Programmable Controller shall have one dedicated serial port that supports RS-232-C signals. It shall be accessible in control logic and provide support for Master and Slave communication protocol systems. Alternatively, it must be usable for programming and data monitoring purposes.

4.2.19 The front panel of the Programmable Controller shall include a holder and a connector for a lithium battery. The battery shall provide power backup for user programs and data when the main power supply is not available.

4.3 PLC Processor

4.3.1 The CPU shall be a self-contained unit, and will provide control program execution and support remote or local programming. This device will also supply I/O scanning and inter-processor and peripheral communication functions.

4.3.2 The user program and data shall be contained in non-volatile, battery backed memory. The operating system shall be contained in non-volatile firmware. The memory containing the operating system can be updated via a separate update tool to allow for easy field updates.

4.3.3 The controller shall contain no less than 100 Kbytes of base memory. It shall provide the capability to increase the memory up to 2 Mbytes.

4.3.4 In a single chassis system all system and signal power to the Controller and support modules shall be distributed on a single motherboard or backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE		
	N65540-00-R-0031	28	OF	72
NAME OF OFFEROR OR CONTRACTOR				

4.3.5 The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a “green” (OK) indicator when no fault is detected and a “red” indicator when a fault is detected.

4.3.6 The front panel on the Controller shall include color indicators showing the following status information:

- ◆ Program or Run mode of the controller
- ◆ The fault status of the controller.
- ◆ IO status
- ◆ RS-232 activity
- ◆ Battery status

4.3.7 Processor mode shall be selected by a keyswitch mounted on the front panel of the CPU. The key shall select the following modes: RUN - No control logic edits possible, program always executing; PROGRAM - Programming allowed, program execution disabled; and REMOTE - Programming terminal can make edits and change processor mode, including TEST mode, whereby the logic executes and inputs are monitored, but edits are not permanently active unless assembled.

4.4 PLC Program Creation and Storage

4.4.1 The program storage medium shall be of a static battery backed RAM type.

4.4.2 Memory capacity shall be configurable to allow for the most economical match to the intended application. It shall be possible to upgrade to a processor with a larger memory size simply by saving a program, installing a memory expansion card, and downloading the program to the new system without having to make any program changes.

4.4.3 Memory shall contain battery back-up capable of retaining all stored program data through a continuous power outage for 2.5 months under worst case conditions. The capability shall exist to remove all batteries from the system

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 29	OF 72
NAME OF OFFEROR OR CONTRACTOR			

without removing system power. A low battery condition must be detectable in ladder logic, but shall not automatically generate a fault.

4.4.4 The operator should be able to backup volatile memory, including data and program logic onto personal computer storage medium.

4.4.5 All user memory in the processor not used for program storage shall be allocable from main memory for the purpose of data storage. The Programmable Controller system shall be capable of storing Predefined, User-defined and Module-defined data types.

4.4.5.1 Predefined data types shall include:

- A. Axis Object
- B. Boolean Values
- C. Control Structure
- D. Counter Values
- E. Integer Values
- F. Double Integer Values
- G. Message Values
- H. Motion_ Group Object Numbers
- I. Motion Instructions
- J. PID Control Structures
- K. Real/Floating Point Values
- L. Signed Integer Numbers
- M. Timer Values

4.4.5.2 User Defined data types shall include user-defined structures. These structures shall be capable of containing one or more pre-defined data members.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 30 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

4.4.5.3 Module-defined data types shall include a structure for each I/O module and system or module specific information (hidden from user). Any data can be displayed in Binary, Octal, Hexadecimal, or Decimal radices.

4.4.6 Base processor memory is available for user program and data.

4.4.7 If contacts or entire rungs are intentionally deleted from an existing logic program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the enlarged program. All rungs shall maintain their original links.

4.4.8 It shall be possible to program select application logic more than once into memory.

4.4.9 The number of times a normally open (N.O.) and/or normally closed (N.C.) contact of an internal output can be programmed shall be limited only by the memory capacity to store these instructions.

4.4.10 The number of times a timer or counter can be programmed shall be limited only by the memory capacity to store these instruction.

4.4.11 Control logic programs shall have immediate access to the subelements of control structures by address and subelement mnemonic, such as timer accumulator value, timer done bit, or PID Process Variable value.

4.5 PLC Communication Interfaces

4.5.1 The Programmable Controller shall have communication interface modules for Ethernet, ControlNet, DeviceNet and Remote I/O(RIO).

4.5.2 Ethernet Communications

4.5.2.1 The Ethernet interface shall support the following:

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 31 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- ◆ Standard TCP/IP communications
- ◆ Standard Ethernet media (10base2, 10base5, 10baseT, fiber)
- ◆ CSMA/CD access method
- ◆ Subnet masking
- ◆ Standard repeaters, bridges, routers, host computers, peer PLCs.
- ◆ RJ-45 and AUI ports
- ◆ Bootp client (selectably turned on or off)
- ◆ Programmable controller messaging to peer controllers and workstations
- ◆ Bridging to ControlNet

4.5.2.2 The Contractor shall provide as part of the IMCS a BOOTP server program to provide programmable controllers their IP address when they power up.

4.5.2.3 The Contractor shall provide as part of the IMCS an API (Application Program Interface) Windows™ operating systems in the form of linkable libraries for C application programs. This API is the software connection to the protocol used by the programmable controllers.

4.5.2.4 On-line programming and upload/downloads of control programs shall be able to occur over the Ethernet network.

4.5.2.5 The Contractor shall offer as part of the IMCS MMI (Man/Machine Interface) software for data acquisition, supervisory control, and information management that obtain data from the programmable controller over the Ethernet network.

4.5.2.6 Software and licenses shall be provided to interface the Windows NT Processor MMI programs with the PLC Processors. Seven (7) licenses shall be provided with each complete IMCS.

4.5.3 ControlNet Communications

4.5.3.1 The Contractor shall offer industry standard 5 megabit/sec ControlNet Producer/Consumer communication capabilities as defined by the ControlNet International 2.0 specification.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 32 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

4.5.3.2 The ControlNet module shall be able to connect to industry standard quad shield Coax using standard BNC style connectors.

4.5.3.3 The ControlNet module shall support Linear, Tree, or Star bus topologies.

4.5.3.4 The ControlNet module shall have a selectable option of using single, or redundant media.

4.5.3.5 There shall be a software protocol layer that uses ControlNet as the transport mechanism to deliver packets of data to other programmable controllers that use the same protocol. This protocol shall handle the addressing and transfer of all the specific data file types in the programmable controller to allow for peer-to-peer messaging.

4.5.3.6 The ControlNet module shall support a maximum of 64 addressable nodes with a repeater, or 48 taps without a repeater.

4.5.3.7 The ControlNet module shall support network update times ranging from 2-100 milliseconds and be user selectable.

4.5.3.8 The Programmable Controller shall have a standard programming instruction that allows peer-to-peer messaging with other controllers over the ControlNet network. The instruction shall be able to address any valid ControlNet node and also messages that need routing to other networks.

4.5.3.9 The ControlNet module shall support scheduled communications between nodes on a single ControlNet link. Also, unscheduled communications between nodes on different links shall be supported.

4.5.3.10 The ControlNet network shall have the capability of being extended by using repeaters. Repeaters shall be available in both coax and fiber varieties

4.5.4 DeviceNet Communications

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 33 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

4.5.4.1 The Contractor shall offer industry standard 125/250/500 Kbaud DeviceNet Producer/Consumer communication capabilities as defined by the Open DeviceNet Contractor's Association (ODVA).

4.5.4.2 The DeviceNet module shall be able to connect to standard DeviceNet cabling and ODVA specified connectors.

4.5.4.3 The DeviceNet bridge module shall support Linear, Tree and Star bus topologies. Trees and Stars can be a max of 20 feet.

4.5.4.4 There shall be a software protocol layer that uses DeviceNet as the transport mechanism to deliver packets of data to peer devices.

4.5.4.5 The DeviceNet module shall support a maximum of 64 addressable nodes.

4.5.4.6 The DeviceNet bridge module shall allow access to a DeviceNet network from programmable controllers and host computers on ControlNet or Ethernet.

4.5.4.7 The programmable controller shall provide special instructions to directly message to I/O devices including instructions to make immediate requests of read and write data on DeviceNet.

4.5.5 RemoteIO Communications

4.5.5.1 The RIO interface shall support the following:

- Two channels of communications
- RIO baud rates shall be 57.6, 115.2, 230.4 KBaud
- Message error checking
- Retries of unacknowledged messages
- Diagnostic checks on other stations

4.6 Processor Interfacing and Peripherals

4.6.1 The programming means of the PLC processor shall be an IBM or compatible, portable, or industrial quality programming terminal provided by the Navy.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE
	N65540-00-R-0031	34 OF 72

NAME OF OFFEROR OR CONTRACTOR

- 4.6.2 The programming terminal will be either connected directly to the PLC processor or via the Ethernet interface.
- 4.6.3 The PLC programming terminal/software shall utilize the Windows NT operating system.
- 4.6.4 PLC Development Software and one (1) license shall be provided with each ship system.
- 4.6.5 The Contractor shall offer a multi-point communication network providing a data transfer path for up to 64 Programmable Controllers and/or mini/micro-computers. The communicating stations shall be distributed anywhere along a single bus that extends a maximum of 10,000 cable feet in length. The communication network shall support the following features:

4.7 PLC Programming Techniques

- 4.7.1 The programming format shall be IEC 1131-3 compliant Ladder Diagram.
- 4.7.2 The controller shall organize user applications as tasks that can be specified as continuous or periodic.
- 4.7.3 Periodic tasks shall run via an interrupt at a user-defined interval in one-millisecond increments to a maximum of 2000 seconds.
- 4.7.4 The interrupt mechanism of periodic tasks shall adhere to the IEC 1131-3 definition of pre-emptive multitasking.
- 4.7.5 The controller shall be able to accommodate a maximum of 32 individual tasks of which one can be continuous.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 35 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- 4.7.6** The periodic tasks shall have an associated, user assignable priority from one to fifteen (one being the highest priority) which specifies that task's relative execution priority in the multitasking hierarchy.
- 4.7.7** Each task shall have a watchdog timeout that is unique to that task and user defined.
- 4.7.8** Each task can include up to 32 programs that can be ordered for execution within the task.
- 4.7.9** Each program can include user ladder logic routines of which one can be specified the main routine and at least one be specified as the fault routine. The number of routines that can be contained in a program is limited only by memory.
- 4.7.10** Variables within the controller shall be referenced as unique, default or user defined tags.
- 4.7.11** Tag naming convention shall adhere to specifications in IEC 1131-2.
- 4.7.12** Tags may be created off-line, on-line in program mode and at the same time the ladder logic is entered.
- 4.7.13** The system shall have the capability to store a description for each tag.
- 4.7.14** Tags shall be available to all tasks in the controller (Controller Scoped) or limited in scope to the routines within a single program (Program Scoped) as defined by the user.
- 4.7.15** Any tag shall have the ability to be aliased by another tag that is defined and has meaning to the user.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 36 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- 4.7.16** The ability to program control logic via tags of the Programmable Controller shall exist.
- 4.7.17** It shall be possible to program ladder rungs with the following restrictions: Series instruction count limited only by user memory, branch extensions limited only by user memory, branch nesting to 6 levels or more.
- 4.7.18** The capability shall exist to change a contact from normally open to normally closed, add instructions, change addresses, etc. It shall not be necessary to delete and reprogram the entire rung.
- 4.7.19** It shall be possible to insert relay ladder diagram rungs anywhere in the program, even between existing rungs, insofar as there is sufficient memory to accommodate these additions.
- 4.7.20** It shall be possible to remove an entire logic rung into an edit buffer where individual parameters may be easily altered.
- 4.7.21** A single program command or instruction shall suffice to delete an individual ladder diagram rung from memory. It shall not be necessary to delete the rung contact by contact.
- 4.7.22** It shall be necessary to issue a two-part command in order to delete all relay ladder rungs from memory. This will provide a safeguard wherein the operator must verify their intentions before erasing the entire program.
- 4.7.23** A clock/calendar feature shall be included within the CPU. Access to the time and date shall be from the programming terminal, user program, or message generation.
- 4.7.24** Latch functions shall be internal and programmable.
- 4.7.25** The system shall have the capability to address software timers and software counters in any combination and quantity up to the limit of available memory. The CPU shall handle all management of these instructions into memory. Instructions shall permit programming timers in the "ON" or "OFF" delay modes.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 37 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

Timer programming shall also include the capability to interrupt timing without resetting the timers. Counters shall be programmable using up-increment and down-increment.

4.7.26 Timer instructions shall have a time base of 1.0 milliseconds. The timing range of each timer shall be from 0 to 2,147,483,648 increments. It shall be possible to program and display separately the timer's preset and accumulated values.

4.7.27 The Programmable Controller shall use a signed integer format ranging from – 2,147,483,648 to +2,147,483,648 for data storage of the counter preset and accumulated values.

4.7.28 The Programmable Controller shall store data in the following formats:

- A. Boolean values (0 or 1).
- B. Short Integer Numbers ranging from –128 to +127.
- C. Integer Numbers ranging from –32,768 to +32,767.
- D. Double Integer Numbers ranging from –2,147,483,648 to +2,147,483,647.
- E. Floating Point Numbers consisting of eight significant digits. For numbers larger than eight digits, the CPU shall convert the number into exponential form with a range of plus/minus 1.1754944 E –38 to plus/minus 3.402823 E +38.

4.7.29 The capability shall exist to organize data in the form of User Defined Data Structures. All aforementioned data types, as well as others, can be used in such structures along with embedded arrays and other User Defined Structures.

4.7.30 The Programmable Controller shall have support for integer and floating point signed math functions consisting of addition, subtraction, multiplication, division, and square root and negation.

4.7.31 Value arrays shall be limited in size only by the amount of available memory.

4.7.32 Arrays shall be configurable with one, two or three dimensions.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE		
	N65540-00-R-0031	38	OF	72
NAME OF OFFEROR OR CONTRACTOR				

- 4.7.33** The CPU shall support indexed addressing of array elements.
- 4.7.34** Array element manipulation instructions such as high speed “array copy” and “array fill”, “array to array” move, “element to array” move, “array to element” move and “first in-first out” shall be supported by the system. The four function math instructions and instructions for performing “logical OR”, “logical AND”, “exclusive OR”, and comparison instructions such as “less than”, “greater than”, and “equal to” shall be included within the system. All instructions shall execute on either single words or arrays.
- 4.7.35** For any module specifically associated with the Programmable Controller, it shall be possible to query the current status of all channels through controller scoped tags without any programming.
- 4.7.36** The system shall contain instructions that will construct asynchronous and synchronous 16 bit word shift registers. Additional instructions shall be provided to construct synchronous bit shift registers.
- 4.7.37** The Programmable Controller shall have a jump instruction which will allow the programmer to jump over portions of the user program to a portion marked by a matching label instruction.
- 4.7.38** The Programmable Controller shall provide a master system clock that will allow synchronization of all axes in the chassis local to the controller.
- 4.7.39** It shall be a function of the CPU to automatically manage all data types. For example, if a word stored in the Integer section of memory is transferred into the Floating-Point section, the CPU shall convert the integer value into floating point prior to executing the transfer.
- 4.7.40** In applications requiring repeatable logic rungs it shall be possible to place such rungs in a subroutine section. Instructions, which call the subroutine and return to the main program shall be included within the system. It shall be possible to program several subroutines and define each subroutine by a unique program

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE
	N65540-00-R-0031	39 OF 72

NAME OF OFFEROR OR CONTRACTOR

file designator. The processor will support nesting of subroutines up to seven levels deep. The program format as displayed on the CRT shall clearly define the main program and all subroutines. It shall be possible to pass selected values (parameters) to a subroutine before its execution. This allows the subroutine to perform mathematical or logical operations on the data and return the results to the main program upon completion. These subroutines will be accessed by jump-to-subroutine instructions.

- 4.7.41** The program format shall display all instructions on a CRT programming panel with appropriate mnemonics to define all data entered by the programmer. The system shall be capable of providing a "HELP" instruction which when called by the programmer will display on the CRT a list of instructions and all data and keystrokes required to enter an instruction into the system memory.
- 4.7.42** At the request of the user, tags contained in system memory shall be displayed on the CRT programming panel. This monitoring feature shall be provided for all tags regardless of format or scope.
- 4.7.43** The system shall have the capability to enter rung comments above ladder logic rungs. These comments may be entered at the same time the ladder logic is entered.
- 4.7.44** The capability shall exist for adding, removing, or modifying ladder logic rungs during program execution. When changes to ladder logic are made or new logic rungs are added it shall be possible to test the edits of such rungs before removal of the prior logic rung is executed.
- 4.7.45** It shall be possible to manually set (force) either on or off all hardwired input or output points from the CRT programming panel or the main chassis front panel. Removal of these forced I/O points shall be either individually or totally through selected keystrokes. The programming terminal shall be able to display forced I/O points.
- 4.7.46** A means to program a fault recovery routine shall exist. When a major system fault occurs in the system, the fault recovery routine shall be executed and then the system shall determine if the fault has been eliminated. If the fault is eliminated, program execution resumes. If the fault still exists, the system will

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE		
	N65540-00-R-0031	40	OF	72
NAME OF OFFEROR OR CONTRACTOR				

shut down. A user shall have the option to either resume operation or to shut down upon fault detection.

- 4.7.47** The capability shall exist for each program to have its own fault routine for program fault recovery. Each having the same features as the controller based fault routine.
- 4.7.48** An instruction shall be available to give the control program diagnostic information, state control, and sequencing of a process simultaneously, while allowing the capability of user-friendly state programming techniques.
- 4.7.49** An instruction shall be supported to incorporate closed loop control systems. The "proportional", "integral", and "derivative" elements shall be accessible to the user in order to tune a closed loop system. This instruction must fully support floating-point math.
- 4.7.50** The system shall support both bit and word level diagnostic instructions.
- 4.7.51** To facilitate conditional event detection programming, output instructions shall include "one shot" instructions, which may be triggered on either low-to-high (rising) or high-to-low (falling) rung conditions.
- 4.7.52** To facilitate debugging, an "always false" instruction shall exist which may be utilized to temporarily inhibit the execution of control logic.
- 4.7.53** The processor shall support Master Control Reset (Relay) type functionality to selectively disable sections of logic.
- 4.7.54** Trigonometric instructions supported must include Sine, Cosine, Tangent, Inverse Sine, Inverse Cosine, and Inverse Tangent. These instructions must fully support floating-point math.
- 4.7.55** Additional floating point instructions supported must include Log 10, Natural Log, and Exponential.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE		
	N65540-00-R-0031	41	OF	72
NAME OF OFFEROR OR CONTRACTOR				

4.7.56 It shall be possible to complete complex, combined calculations in a single instruction, such as flow totaling or equations of the format $((A+((B-C)*D))|E)$.

4.7.57 File function instructions supported shall also include Sort, Average, Square Root, and Standard Deviation.

4.7.58 The processor shall include direct support of FOR . . NEXT loop constructions.

4.8 PLC I/O Modules

4.8.1 The following different types of I/O Modules shall be made available for use it the PLC chassis:

- A. 16 channel Normally Open Relay Module
- B. 8 channel Normally Open/Closed Relay configurable Module
- C. 16 channel 20-30 VDC Output Module
- D. 16 Channel 10-30 VDC Discrete Input Module
- E. 16 Channel 10-30 VDC Diagnostic Discrete Input Module. The card must be able to detect a wire break versus an open contact using a 7k resistor at the contact.
- F. 6 channel Thermocouple Input Module. The card must support Type K thermocouple.
- G. 6 channel RTD Input Module. The card must support the DIN392 Platinum RTD curve or MIL 24388-C Platinum Curve.
- H. 16 channel Analog Input Module capable of 0-5Vdc, 0-10 Vdc, +-10Vdc, 0-20mA,. The card accuracy must be 0.15% of full scale or better.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 42 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- I. 6 channel Isolated Analog Input module capable of 0-5 Vdc, 0-10 Vdc, +-10 Vdc, 0-20mA. The card accuracy must be 0.10% of full scale or better.
- J. 6 channel isolated 13 bit Analog Output Module capable of +- 10Vdc.
- K. A module capable of high speed power system monitoring, power system synchronization and load sharing. The module must be capable of measuring Voltage and Current from the two three-phase systems and provides control and error signals to implement automatic governor control and synchronization. The module will generate breaker closure commands within specified windows.

5. OPERATOR TERMINALS

- 5.1.1 The Contractor shall provide two (2) Operator Terminals per ship set that can be connected to the PLC Processors and used for Local Control and Monitoring.
- 5.1.2 The Operator Terminals shall be of Flat Panel design that utilize Active Matrix Thin Film Transistor (TFT) technology.
- 5.1.3 The Operator Terminal shall contain a visual display that is no less then 8 inches in diagonal length.
- 5.1.4 The Operator Terminal display shall have no less then a 640X480-pixel resolution.
- 5.1.5 The Operator Terminal display shall be color.
- 5.1.6 The Operator Terminal shall contain a replaceable backlight.
- 5.1.7 The Operator Terminal shall contain no less then 1 Megabyte of application memory.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 43 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- 5.1.8** The Operator Terminal shall contain a keypad that contains no less then sixteen (16) function keys, a numeric keypad and 4 arrows for cursor manipulation.
- 5.1.9** The Operator Terminal shall have a NEMA 4 rating.
- 5.1.10** The Operator Terminal shall utilize 115 VAC power.
- 5.1.11** The Operator Terminal shall be capable of operating in an enclosed space with ambient room temperatures of 0 to 122 degrees F and humidity 5 to 95% noncondensing.
- 5.1.12** The Operator Terminal shall weigh less then 8 pounds.
- 5.1.13** The Operator Terminal housing rigid, self-supporting structures, with suitable structural reinforcement, stiffening and bracing. When panels are assembled, the surfaces shall be flat and smooth.
- 5.1.14** The Operator Terminal shall be capable of displaying Graphical User Interface (GUI) displays such as pushbuttons, screen selectors, numeric keypads, diagnostic indicators, message displays, bar graphs, ASCII displays and list indicators.
- 5.1.15** The Operator Terminal development software shall utilize the graphical interface of the Microsoft Windows Operating System.
- 5.1.16** The Contractor will supply as part of the IMCS software to develop the Operator Terminal GUI displays.

6. CONTRACTOR ASSEMBLED SYSTEMS GENERAL REQUIREMENTS

- 6.1** The Contractor shall assume single source responsibility for system assembly. An assembled system may include enclosures, mounting and wiring of relays, motor starters, transformers, and disconnecting means, interface cables and connectors or other control devices as specified by customer-supplied documentation.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 44 OF 72
---------------------------	---	--

NAME OF OFFEROR OR CONTRACTOR

- 6.2** The Contractor shall have the capability to supply an enclosure with special paint and graphic displays.

- 6.3** The Contractor shall wire all Programmable Controller inputs and outputs to customer-specified terminal blocks.

- 6.4** The assembled system shall include fuse blocks that meets the Government size requirement that will be provided within 30 days after contract award.

- 6.5** Within the enclosures all I/O racks, processor racks, and power supplies shall be grounded to meet the specifications.

- 6.6** If more than one controller is mounted within an enclosure, the capability must exist to share a single programming panel.

- 6.7** All pushbuttons, switches and other operator devices must be UL listed and/or CSA approved, and sufficiently large and durable to provide dependable, long life operation.

- 6.8** All cables (with associated plugs, connectors and receptacles) requiring user field installation, shall be designed for commercial use to withstand an industrial environment.

- 6.9** The Contractor shall submit preliminary drawings of the complete assembled system for approval by the Government.

- 6.10** The Government shall conditionally approve or disapprove the drawings within 15 days after receipt. Prior to approval of the preliminary drawings, the acquisition of materials, or components for, or the commencement of production on the IMCS is at the sole risk of the contractor.

- 6.11** All drawings shall include page, sheet, and line numbers.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 45 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

- 6.12** The first page of all drawings and schematics shall be a cover sheet consisting of a Bill of Material, purchase order number, Contractor's job number, user's name, location, application, and shipping address.
- 6.13** The drawings shall include a mechanical layout detailing the overall external dimensions of the enclosure. The drawings shall include such pertinent information as location of door handles, windows, lifting lugs, and enclosure mounted items such as tachometer or current meters, cooling fans, etc.
- 6.14** The Contractor shall provide documentation detailing the mounting of the processor, I/O racks, motor starters, disconnect switch, fuse blocks, wireways, etc. All materials shall be labeled to provide easy cross-reference to the Bill of Material listing.
- 6.15** Electrical prints detailing all hardwiring, done by the Contractor, to devices such as relays, motor starters, disconnect switches, fuse blocks, etc. shall be provided with individual wire numbers and relay contact cross-reference designations.
- 6.16** Sections describing inputs shall designate input modules by name, rack, module, and terminal location.
- 6.17** Each limit switch, pushbutton, or other input device shall be connected to only one individual input point.
- 6.18** Each output device shall be connected to only one individual output point.
- 6.19** The last sheet in the set shall be for terminal block designations each containing their individual terminal numbers.
- 6.20** One (1) reproducible copy of the Final Drawing shall be delivered with the System.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 46 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

7. ENVIRONMENTAL SPECIFICATIONS

- 7.1** All material within the enclosures must be able to meet the following environmental requirements:
- A. Shock specifications must meet MIL STD 901D
 - B. Vibration specifications must meet MIL STD 167 1 (Ships)
 - C. RFI specifications must meet current version MIL STD 461
 - D. All material must be able to operate in 130 degree F Ambient environments
 - E. All material must be able to operate with external humidity ranging from 5% to 95% non-condensing.

The Contractor shall provide environmental certification

8. TRAINING

- 8.1** The Contractor shall offer a customer-training program designed to teach the customer's personnel in the understanding and application of the programmable controller. The training program shall include training manuals and "hands-on" programming experience on a Programmable Controller of a type similar to that provided by the Contractor.

9. SPARE PARTS

- 9.1** Spare parts shall be supplied with each IMCS.
- 9.2** For each ship set, the Contractor shall provide a list of spares for the PLC processors, each PLC I/O card, PLC Power Supply, each Support Box Power Supply, Transducers, Relays or any other electronic device in the PLC/Support Box. The spare parts list will be based on the Mean Time Between Failure (MTBF) of each component. The life expectancy of this system shall be twenty Years.

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED N65540-00-R-0031	PAGE 47 OF 72
---------------------------	---	----------------------------

NAME OF OFFEROR OR CONTRACTOR

10. TECHNICAL SUPPORT

- 10.1** The Contractor shall provide an onsite representative with the knowledge of programming, hardware, and installation of the PLC systems for no less than 1 year.
- 10.2** Engineering support can be requested on an as-needed basis and can range from one day up to four months. This support may not be in consecutive days and can be spread out over the period of the contract.
- 10.3** The contractor will provide hourly rates for the following types of activity:

Labor Rate on-site Sunday – Saturday @ 12 hours per day
Labor Rate on Holiday
Travel Rates
Overnight expenses

10.4 Field services representatives shall provide miscellaneous material such as fuses, diodes, connectors, etc. in support of on-site service of PLC system.

11. TECHNICAL MANUALS

- 11.1** The Vendor shall provide operating instruction manuals with adequate information pertaining to the following:
- A. System specifications
 - B. Electrical power requirements
 - C. Application considerations
 - D. Assembly and installation procedures
 - E. Power up procedures
 - F. Troubleshooting procedures
 - G. Programming procedures
 - H. Explanation of internal fault diagnostics
 - I. Shut down procedures
 - J. Recommended spare parts list
 - K. Preventive Maintenance procedures
- 11.2** A complete set of documentation shall be supplied with each ship system delivered.